Transit of Titan's Shadow across the Disk of Saturn, on 15th April, 1862. By the Rev. W. R. Dawes.

The sixth satellite of *Saturn* (*Titan*) passed its inferior conjunction with the planet on the night of April 15th, and soon afterwards the shadow of the same satellite transited the disk of *Saturn*.

At $10^h\ 31^m$ G.M.T. *Titan* was judged to be at its nearest approach to the planet's north pole. The air was not in a sufficiently good state to render of any use a higher power than 300 on my $8\frac{1}{4}$-inch refractor. With this, the best views showed the satellite quite round, and in loose contact with the disk; but conveying the impression that if the air had been perfectly pure and quiet, a very slight separation might perhaps have been discerned.

Soon after 11^h (time not precisely noted), a shallow circular notch was cut out on the eastern edge of the disk, about one second or a second and a half to the north of the edge of the ring at that place.

At $11^h\ 8^m$, the shadow was judged to have entered one-half its own diameter, the semicircular notch appearing of very considerable size.

At $11^h\ 14^m$, the internal contact was noted; and, in less than half a minute afterwards, the edge of the planet's disk was perceived as a most delicate line of light. The state of the air had improved at this time, and definition with the power then in use (296) was frequently very sharp and steady.

Soon after this, I applied the parallel-wire micrometer, intending to measure the distance between the courses described by the satellite and its shadow, in the direction perpendicular to the axis-major of the ring; but inadvertently the webs were set parallel to the *Earth's* equator instead of *Saturn's*. The mean of six very good measures (with power 286) gave this distance (or *difference of declination*) $= 6''{\cdot}84$. Taking the inclination of the semi-axis-minor of the ring to the circle of declination at $5^\circ\ 12'$, as given in the Table on page 485 of the *Nautical Almanac* for the present year, this difference of declination becomes $7''{\cdot}83$, as measured in the direction *perpendicular* to the axis-major of the ring.

The mean of twelve measures of the *difference of right ascension* of the satellite and its shadow, gave $11''{\cdot}24$; which, reduced in a similar manner, becomes $10''{\cdot}58$ for the distance in the direction *parallel* to the axis-major of the ring.

The shadow passed along the southern edge of the northern equatoreal belt, encroaching on the belt by nearly one-third of its own diameter.

At $13^h\ 46^m$, the shadow was judged to be precisely in the middle of the chord it described; and this was tested by the webs of the micrometer, which had been previously separated

to a distance equal to the equatoreal semi-diameter of *Saturn;* and each web being placed alternately on the shadow by the quick slipping-piece attached to the driving cylinder, the webs were found to measure equally well both the eastern and western side of the disk.

After the shadow had passed the middle of its transit, I took eight measures of the distance between the satellite and its shadow in the direction parallel to the axis-major of the ring, the mean of which was 10″·89. But the state of the air had by this time greatly deteriorated, and the planet was between four and five hours west of the meridian. I therefore prefer the result of the calculation given above, namely, 10″·58.

On the 2d of November, 1789, a similar phenomenon was observed by Sir W. Herschel. He gives the time when he "discovered a black spot on the following margin of the disk of the planet." But this might probably be some minutes after the centre of the shadow coincided with the edge of the disk. Sir William gives $2^h\ 8^m\ 51^s$ as the time which elapsed between his discovery of the spot and its attaining a central position on the disk. The interval between the bisection of the shadow by the limb and its central situation in my observation was $2^h\ 38^m$. The part of the disk transited was nearly the same on both occasions.

I am not acquainted with any other observations of this interesting phenomenon. In the years 1848 and 1849, when the Sun was nearly in the plane of the ring, I looked out diligently for the transits of *Titan* and its shadow; but either from clouds, or the transit occurring in daylight or when the planet was below the horizon, I was never able to observe it; nor have I heard of any other observer who was more fortunate. During the present apparition of the planet also, I have, until the recent occasion, in vain watched for the occurrence of the phenomenon. It will occur again on May 1st and 17th; but I believe that on both those occasions the shadow will be hidden from our view by the interposition of the ring. On the 1st, the path of the shadow will lie within 1″ to the north of *Saturn's* equator; and on the 17th it will fall on the ring itself, which, from its extremely feeble illumination, will appear as a very dark line across the planet; and it seems exceedingly doubtful whether the shadow, notwithstanding its intense blackness, will be at all discernible upon it.

The *size* of the shadow, however, is far greater than I was prepared to expect. I carefully estimated it at little less than 1″ in diameter — certainly not less than 0″·8. It may reasonably be concluded from this that some part of the surface of the satellite is not very reflective; and that, with a large amount of optical power, it might perhaps be perceived as a *dark spot* on the disk of the planet (as is *always* the case with the third and fourth satellites of *Jupiter*), especially if

it should happen in its transit to be projected on the bright equatoreal region. This, however, will not occur during the present season; for though, on August 5th, *Titan* will transit the northern portion of that region, yet it will occur while daylight is so strong as to render it utterly improbable that the satellite could be seen on the disk at all, and very unlikely that even its shadow should be detected.

The third transit of the shadow from the present time will occur on the evening of June 2d; and as it will then fall on the *south* side of the ring, it may probably be seen passing along the southern edge of the extremely narrow *shadow of the ring;* and as its ingress will not take place till about fifty minutes after sunset, and the planet will be only about $2\frac{1}{2}$ hours west of the meridian, it is hoped that the phenomenon will be extensively observed, if the sky should be clear.

The following will be approximately the times of the ingress of *Titan's* shadow for the next seven transits; but the strong daylight and the planet's distance from the meridian will combine to render the last two or three of them very difficult to observe, if not absolutely invisible.

Approximate G.M.T. of Ingress of the Shadow of *Titan*.

			h	m
1862,	May 1,	at	10	24
	17,		9	41
	June 2,		8	57
	18,		8	14
	July 4,		7	30
	20,		6	47
	Aug. 5,		6	3

From the great size of the shadow, I believe that the ordinary aperture of a 5-foot refractor ($3\frac{3}{4}$ to 4 inches) would suffice to show it under favourable circumstances of atmospheric purity and altitude of the planet, provided the defining power of the instrument is extremely good.

Hopefield Observatory, Haddenham, near Thame,
1862, April 28.

Transit of Titan's Shadow over the Disk of Saturn, on 1st May, 1862. By the Rev. W. R. Dawes.

Clouds most unfortunately prevented the observation of the transit of the shadow of *Titan* over the disk of *Saturn* on the night of May 1st. A glimpse showed the satellite near its inferior conjunction at $8^h\ 15^m$; but after that the planet re-